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< Desc/Cls PAGE NUMBER 1>

Light guidance body as well as method to its production the current invention concern light guidance bodies, which exhibit at least a light-introduction-flat and at least a light-withdrawal-flat as well as a 2 mm thick, photoconductive layer, whereby the ratio from light-withdrawal-flat to light-introduction-flat amounts to at least 4.

Such light guidance bodies are actual known. So a transparent plate can be provided with notches, at which light normal is uncoupled to propagation direction. Such light guidance bodies are subject-matter of EP 800,036. Applying of notches is however expensive, so that after alternatives sought becomes.

The other 656,548 light guidance bodies are known from EP, which use

In particular a decomposed intensive W-irradiation the plastic particles, so that W-irradiation leads to a Gelbstich. This Gelbstich is again very critical for the use as light guidance body, since an uneven color impression develops.

Beyond that 1022129 light guidance bodies known, which exhibit a particle-free photoconductive layer from polymethyl methacrylate, are on which a diffuse equipped layer applied are from EP. Those diffuse equipped layer, the one thickness in the range

< Desc/Cls PAGE NUMBER 2>

from 10 to 1500 ssm, covers barium sulfate exhibits particles. In accordance with this principle the light becomes passed over the PMMA layer, whereby uncoupling by the diffuse layer made. However the light uncoupling can become hardly controlled, since only the light becomes normal the propagation direction scattered, which has the barrier layer to the diffuse equipped layer penetrated. It concerns here accordingly not around a perturbation within the photoconductive layer, but a diffuse back reflection. Beyond that the decrease of the illuminating intensity is very large, as the examples occupy this.

From this a small luminance results in the case of long distance to the light source, which is not sufficient for many applications. The small lightness with larger distance of the light source of the light guidance body in accordance with EP 1022129 leads the other to an high sensitivity opposite the formation of scratches on the exit face of the light.

Problematic one is here that these On this principle the teaching of EP 800,036 is based. These places of malfunction do not step out during an high light uncoupling.

Considering the state of the art discussed indicated herein and it was therefore to be indicated to object of the current invention light guidance body, which exhibits a special weathering resistance.

Here the light guidance bodies one should on those

< Desc/Cls PAGE NUMBER 3>

Needs adaptable light uncoupling make possible, without notches become applied on the plate.

Beyond that the luminance should be over the whole area the light-withdrawal-flat if possible constant.

An other object of the invention consisted of the fact that the

The other the invention the object was the basis to make light guidance bodies available which particularly simple prepared to become to be able. Thus the light guidance bodies should be able to become in particular by extrusion, injection moulding as well as by casting procedure generated.

Beyond that it was therefore object of the current invention to create light guidance bodies which inexpensive prepared to become to be able.

An other object of the current invention consisted of indicating light guidance bodies which show excellent mechanical properties. This property is in particular important for applications, with which the light guidance body is to exhibit an high stability against impact effect.

An other object of the current invention consisted of making light bodies available which in size and form the requirements adapted to become in a simple manner to be able.

< Desc/Cls PAGE NUMBER 4>

Dissolved one these objects as well as other, which become not literally mentioned, however from the connections



discussed herein to be derived to be able as natural or from these inevitably result, from the light guidance body described in claim 1. Convenient modifications of the light guidance bodies according to invention become in the Unteransprüchen backbased on claim 1 bottom protection provided.

Regarding methods to the production the claims 11 and 12 supply a solution of at the basis located object.

By the measures according to invention become and. A. in particular the subsequent advantages achieved:

< Desc/Cls PAGE NUMBER 5>

The light guidance bodies of the current invention can be manufactured particularly simple. So the light guidance bodies can by extrusion, Injection moulding as well as by casting procedure prepared become.

 top

'The other according to invention show

Light guidance body a particularly uniform

Distribution of the luminance. Here various large light guidance bodies can become prepared, without the brilliance distribution would be in special measure critical.

'The light guidance bodies of the current invention beyond that show a particularly colorfast

Light, so that with increasing distance of that

Light source no yellow impression develops.

'The lightness of the light guidance bodies can to those

Needs adapted become.

The photoconductive layer of the light guidance body according to the present invention points 0.001 to 0.08, preferably to 0.001 to 0.06 and particularly preferred 0.001 to 0.04 thread. - %, related to the weight of the photoconductive layer, spherical barium sulfate particles up.

< Desc/Cls PAGE NUMBER 6>

The term spherical referred in the frame of the current invention that the particles preferably exhibit a spherical shape, whereby the skilled person obvious is that due to the manufacturing methods also particles with other shape can be contained, or that the form of the particles can deviate from the ideal Kugelgestalt.

Accordingly the term spherical means that the ratio of the largest expansion amounts to the particle to the smallest expansion maximum 4, preferably maximum 2, whereby these expansions become by the center of gravity the particle measured in each case. Preferably at least 70%, particularly preferred at least 90%, related to the number the particle, are spherical.

The barium sulfate particles have an average diameter (weight average) within the range of 0,3 to 20 over, preferred from in particular within the range of 1,4 to 3.5 ssm. To favourable way 75% of the particles lie within the range of 0,3 to 6 over. The determination of the particle size made by means of X-raying the a graph. Here the setting off behavior of the barium becomes sulfate in the gravity field by means of X ray followed.

On the basis the transparency for X ray closed (the principle of the absorption of X ray will used, in order to determine the direct changes in the mass concentration, if particles in a liquid sedimentieren in accordance with the Stokes' law) becomes on the particle size.

Barium sulfate particles, those the properties specified above exhibit are actual known and

< Desc/Cls PAGE NUMBER 7>

commercial among other things of Sachtleben chemistry GmbH, D-47184 Duisburg available. Beyond that various methods are known to the production.

In accordance with a particular aspect of the current invention these particles evenly distributed in the plastic matrix are present, without a considerable aggregation or Zusammenlagerung of barium sulfate particles arises. Evenly distributed one means that the concentration at barium sulfate is essentially constant within the plastic matrix.

For the guarantee of this distribution the particle in the plastic matrix are the skilled person, depending upon type of the production of the plastic body, various methods known. If the photoconductive layer becomes prepared in the casting procedure, then for example agents can become added, which prevent a settling of the barium sulfate, and so a fine distribution to ensure. If the photoconductive layer becomes from thermoplastic mouldable polymethyl methacrylate prepared, then the moulding compounds known dispersion aids can become accompanying.

The photoconductive layer according to invention covers at least 60 thread. - %, related to the weight of the photoconductive layer, polymethyl methacrylate.

These polymers become generally obtained by radical polymerization of mixtures, which contain methyl methacrylate. Generally these mixtures contain at least 40 thread. - %, preferably at least 60 thread. - % and



particularly preferred at least 80 thread. - %, related to the weight of the monomers, methyl methacrylate.

< Desc/Cls PAGE NUMBER 8>

Besides these mixtures can contain of other [REDACTED] which are more copolymerizable with methyl methacrylate. The term (Meth) acrylates covers methacrylates and acrylates as well as mixtures from both. These monomers are far away known. To these among other things (Meth) acrylates, which are derived from satisfied alcohols, belong as for example to methyl acrylate, ethyl (meth) acrylate, Propyl (meth) acrylate, n-butyl (meth) acrylate, third. - Butyl (meth) acrylate, Pentyl (meth) acrylate and 2-Ethylhexyl (meth) acrylate; (Meth) of acrylates, which are derived from unsaturated alcohols, like z. B. Oleyl (meth) acrylate, 2-Propinyl (meth) acrylate, allyl (meth) acrylate, vinyl (meth) acrylate; Aryl (meth) of acrylates, like benzyle (meth) acrylate or Phenyl (meth) acrylate, whereby the aryl radicals can be unsubstituted in each case or up to quadruple substituted; Cycloalkyl (meth) of acrylates, like 3-Vinylcyclohexyl (meth) acrylate, Bornyl (meth) acrylate; Hydroxyl alkyl (meth) of acrylates, like 3-Hydroxypropyl (meth) acrylate, 3, 4-Dihydroxybutyl (meth) acrylate, 2-Hydroxyethyl (meth) acrylate, 2-Hydroxypropyl (meth) acrylate; Glycoldi (meth) of acrylates, like 1, 4-Butandiol (meth) acrylate, (Meth) acrylates of Etheralkoholen, like Tetrahydrofurfuryl (meth) acrylate, Vinyloxyethoxyethyl (meth) acrylate; Amides and nitriles (Meth) of the acrylic acid, like n (3-Dimethylaminopropyl) (meth) acrylamide, n (Diethylphosphono) (meth) acrylamide, 1-Methacryloylamido-2-methyl-2-propanol;

< Desc/Cls PAGE NUMBER 9>

schwefelhaltige methacrylates, like Ethylsulfinylethyl (meth) acrylate, 4-Thiocyanatobutyl (meth) acrylate, ethyl sulphonyl ethyl (meth) acrylate, Thiocyanatomethyl (meth) acrylate, Methylsulfinylmethyl (meth) acrylate, to ((meth) acryloyloxyethyl) sulfide; multi-valued (Meth) acrylates, like Trimethyloxypropantri (meth) acrylate.

Beside (Meth) the acrylates stated before the compositions which can be polymerized can exhibit also other unsaturated monomers, which are more copolymerizable with methyl methacrylate and (Meth) the acrylates specified before.

To it among other things 1-Alkene, like Hexen-1, belongs Hepten-1; branched alkenes, as for example Vinylcyclohexan, 3, 3-Dimethyl-1-propen, 3-Methyl-1-diisobutylen, 4-Methylpenten-1; Acrylonitrile; Vinyl ester, like vinyl acetate; Styrene, substituted styrenes with an alkyl substituent in the side chain, like z. B. A - Methylstyrene and ethyl styrene, substituted styrenes with alkyl substitute ducks at the ring, like vinyl toluene and p-methylstyrene, halogenated styrenes, as for example mono chlorine styrenes, Dichlorostyrole, tri bromine styrenes and Tetrabromstyrole; Heterocyclic vinyl compounds, like 2-Vinylpyridin, 3-Vinylpyridin, 2-Methyl-5-vinylpyridin, 3-Ethyl 4-vinylpyridin, 2, 3-Dimethyl-5-vinylpyridin, Vinylpyrimidin, Vinylpiperidin, 9-Vinylcarbazol, 3-Vinylcarbazol, 4-Vinylcarbazol, 1-Vinylimidazol, 2-Methyl-1-vinylimidazol, N-vinylpyrrolidone,

< Desc/Cls PAGE NUMBER 10>

2-Vinylpyrrolidon, N-Vinylpyrrolidin, 3-Vinylpyrrolidin, N-vinylcaprolactam, N-Vinylbutyrolactam, Vinyloxolan, Vinylfuran, Vinylthiophen, Vinylthiolan, Vinylthiazole and hydrogenated Vinylthiazole, Vinyloxazole and hydrogenated Vinyloxazole; Vinyl and Isoprenylether; Maleic acid derivatives, as for example maleic anhydride, methyl maleic acid anhydride, maleimide, methyl mark A IMIDE; and dienes, as for example divinylbenzenes.

Generally become these comonomers in an amount from 0 to 60 thread. - %, preferably 0 to 40 thread. - % and particularly preferred 0 to 20 Gew. - %, related to the weight that monomers, used, whereby the connections single or as mixture used to become to be able.

The polymerization becomes generally started with known radical initiators. To the preferred initiators among other things far away the Azoinitiatoren, like AIBN and 1, known in the professional world, belongs 1-Azobiscyclohexanecarbonitril, as well as peroxy compounds, like Methyllethylketonperoxid, acetylacetone peroxide, Dilaurylperoxyd, third. - Butylper-2 ethylhexanoat, Ketonperoxid, Methylisobutylketonperoxid, Cyclohexanonperoxid, Dibenzoylperoxid, third. - Butyl peroxybenzoate, third. - Butylperoxyisopropylcarbonat, 2,5-Bis (2-ethylhexanoyl peroxy) -2,5-dimethylhexan, third. - Butylperoxy-2ethylhexanoat, third. - Butylperoxy-3, 5,5 -, dicumyl peroxide, 1, 1-Bis (third trimethylhexanoat. - butylperoxy) cyclohexane,

< Desc/Cls PAGE NUMBER 11>

1, 1-Bis (third. - butylperoxy) 3,3, 5-trimethylcyclohexan, Cumylhydroperoxid, third. - Butyl hydroperoxide, to (4-tert. - peroxydicarbonat with one another butylcyclohexyl), mixtures connections mentioned by two or more of the aforementioned connections as well as mixtures of the aforementioned connections with, which can likewise form radicals.

These connections become frequent in an amount from 0,01 to 10 thread. - %, preferably of 0,5 to 3 Gew. - %, related to the weight that monomers, used.

Here various Poly (meth) can become acrylates used, which differ for example in the molecular weight or in the monomer composition.

The other the moulding compounds can contain of other polymers, in order to modify the properties. To it belong among other things polyacrylonitriles, polystyrenes, polyethers, polyesters, polycarbonates and polyvinyl chlorides. These polymers can become single or as mixture used, whereby also copolymers, which are derivable of polymers specified before, which moulding compounds accompanying to become to be able.

So particularly preferred moulding compounds are the bottom trade name PLEXIGLASS from the company Röhm GmbH commercial available.

The weight average molecular weight Mw that according to invention as matrix polymers the one which can be used Homo and/or copolymers can vary in wide ranges, whereby the molecular weight becomes usually tuned on the



application purpose and the manner of processing of the moulding compound. Generally it lies however

< Desc/Cls PAGE NUMBER 12>

in the range between 20,000 and 1,000,000 g/mol, preferably 50,000 to 500,000 g/mol and particularly preferred 80,000 to 300,000 g/mol, without thereby a limitation is to take place.

After addition the barium sulfate particle can become from these moulding compounds photoconductive layers by conventional thermoplastic moulding processes prepared. To it belong in particular the extrusion as well as the injection moulding.

The other photoconductive layers of the current invention can become by casting procedures prepared. Here suitable acrylic resin mixtures in a form become given and polymerized.

A suitable acrylic resin covers for example A) 0, 001-0, 08 Gew. - % spherical barium sulfate

Particle with an average diameter in

Range from 0,7 to 6 mm, B) 40-99, 999 thread. - % methyl methacrylate, C) 0-59, 999 Gew. - % comonomers, D) 0-59, 999 thread. - % in (B) or (C) soluble

Polymers, whereby the components A) to D) 100

Gew. - % result in.

Beyond that the acrylic resin exhibits the initiators necessary to the polymerization. The components A to D as well as the initiators correspond to the connections, which become also the production suitable polymethyl methacrylate moulding compounds used.

To the cure one knows z. B. the so called casting chamber procedure (S. z. B. the DE 25 44 245, EP-B 570,782 or EP-A 656,548) uses, with the polymerization

< Desc/Cls PAGE NUMBER 13>

a plastic disk between two glass plates made, which become sealed with a circumferential cord.

In accordance with a particular embodiment of the current invention the photoconductive layer points at least 70, preferably at least 80 and particularly preferred at least 90 Gew. - %, related to the weight of the photoconductive layer, polymethyl methacrylate up.

The Poly (meth) of acrylates of the photoconductive layer exhibits measured with the well-D line (589 Nm) in accordance with a particular aspect of the current invention a refractive index and with 20 C within the range of 1,48 to 1.54.

The moulding compounds as well as the acrylic resins can contain conventional additives of all type. To it belong among other things antistatic agents, Antioxidantien, releasing from form means, flame retardants, lubricants, dyes, flow improvement means, fillers, light stabilisers and organic phosphorus compounds, like phosphites or phosphonates, pigments, decomposition protective agents and softeners.

The amount at additives is however limited on the application purpose. So the photoconductive property of the polymethyl methacrylate layer should not become strong by additives affected.

The photoconductive layer exhibits generally a transmission within the range of 80 to 92%, preferred from 83 to 92, without thereby a limitation is to take place. The transmission can become in accordance with DIN 5036 certain.

< Desc/Cls PAGE NUMBER 14>

The photoconductive layer of the light guidance body exhibits at least according to invention a thickness of 2 mm.

Preferred one is appropriate the thickness of the photoconductive layer within the range of 2 to 100 mm, for particularly preferred from 3 to 20mm.

The light guidance bodies of the current invention exhibit at least a light-introduction-flat and at least a light-withdrawal-flat.

The term light-withdrawal-flat marks here a surface light guidance body, those suitable is light to be radiated. The light-introduction-flat again is to be taken up in the layer light to the body, so that the photoconductive layer can distribute the introduced light over the entire light-withdrawal-flat. The photoconductive layer exhibits a thickness of at least 2 mm. The barium sulfate particles lead to an uncoupling of the light, so that light withdraws over the entire light-withdrawal-flat.

Here the ratio from light-withdrawal-flat to light-introduction-flat amounts to at least 4, preferably at least 20 and particularly preferred at least 80.

From this it results that the light guidance body of the current invention differs in strong measure from known covers for lighting fixtures. These covers are characterised by the fact that the light-introduction-flat is parallel formed to the light-withdrawal-flat, so that both surfaces exhibit into for instance the equal size.

< Desc/Cls PAGE NUMBER 15>

The amount at uncoupled light is dependent of the amount at barium sulfate particles in the plastic matrix.

Per large this amount, the probability is the larger that light from the light pipe is uncoupled. From this it results that the amount at barium sulfate of size is the light-withdrawal-flat dependent. The further the expansion of the light guidance body is vertical to the light-introduction-flat, the amount at barium sulfate particles in the photoconductive layer selected becomes the smaller.

In accordance with a preferred aspect of the current invention the light guidance body can accept a tabular shape, whereby the three expansions of the body exhibit a varying size.



A such board is for example in the figs 1 and 2 schematically illustrated. Here the reference numeral 1 marks the edges of the board, which can serve in each case as light-introduction-flat.

Reference numeral 2 describes the light-withdrawal-flat of the board.

The smallest expansion is here the thickness of the board. The largest expansion is defined as length, so that the third dimension represents the width.

From this it results that the light-withdrawal-flat of this embodiment becomes defined by surface, which corresponds to the product from Länge\*Breite. The edges of the board, in each case defined as surface, which becomes formed by the product from Länge\*Dicke or Breite\*Dicke, can generally as light-entrance-flat

< Desc/ Clms PAGE NUMBER 16>

serve. Preferably those become polished as light entrance flat serving edges.

Prefered one exhibits a such light guidance body a length within the range of 25 mm up to 3000 mm, preferably from 50 to 2000 mm and particularly preferred from 200 to 2000 mm.

The width of this particular embodiment lies generally within the range of 25 to 3000 mm, of preferred wise of 50 to 2000 mm and particularly preferred from 200 to 2000 mm.

A such light guidance body exhibits a thickness of more than 2 mm, preferably within the range of 3 to 100 mm and particularly preferred from 3 to 20. In addition, beside these cubic embodiments are itself toward a side tapering embodiments, which exhibit the form of a wedge, more conceivable. With the wedge form light-entrance-flat light becomes a coupled only over.

Depending upon arrangement of the light sources here the light can become over all four edges irradiated. This can be with very large light guidance bodies necessary in particular. With smaller light guidance bodies generally or two light sources are sufficient.

In accordance with a preferable embodiment of the current invention light-withdrawal-flat vertical stands to the light-introduction-flat.

To the better evaluation of the used light energy can do the edges, those not with a light source

< Desc/ Clms PAGE NUMBER 17>

are provided, reflective equipped become. This equipment can take place for example via reflective adhesive tapes. The other a reflective lacquer can become on these edges applied.

In accordance with a particular embodiment of the current invention the light guidance body consists of the photoconductive layer, whereby the edges of the photoconductive layer if necessary reflective equipped to become to be able.

The light guidance body as well as the photoconductive layer exhibit excellent mechanical and thermal properties. These properties cover in particular a Vicat softening temperature according to ISO 306 (B50) from at least 95 C and an elastic module according to ISO 527-2 from at least 2000 MPa.

The light guidance body of the current invention can serve in particular for the illumination of LCDs, signs and Reklametafeln.

The illumination the light-introduction-flat can become all known light sources used. Suitable ones are punctiform incandescent lamps, z. B. Niedervolt halogen lamps, or several ends of light pipes, or several light emitting diodes as well as tubular halogen lamps and fluorescent tubes.

These know z. B. in a frame at an edge, and/or. an edge face or a front surface, lateral that indirect surface which can be illuminated, the light guidance body disposed its.

< Desc/ Clms PAGE NUMBER 18>

The light sources can be to the better irradiation of the light guidance body with reflectors equipped.

Subsequent one becomes the invention by examples and comparison examples incoming explained, without the invention is to become limited on these examples.

Example 1 production of a white paste: In 94 thread. Parts methyl methacrylate 5 thread become. Parts polymethyl methacrylate with a n spez/C of 50-55 ccm/g dissolved. This solution 1.0 thread become. Parts bare one fixed N washed, the company Sachtleben chemistry GmbH, D-47184 Duisburg, added.

This mixture becomes at a rotor stator Dispergator (Ultra Turrax T 50 of the companies Janke and Kunkel, Freiburg) with approx.

700 rpm. up to a temperature of 55 C dispersed and afterwards on room temperature cooling calmly.

B) Production of a polymerization beginning: 1.8 thread. - % white paste becomes 98.2 thread. - % MMA/PMMA syrup with approx. 25% PMMA portion (n Spez/C of 75) course give. This approach become 0.075% 2,2-Azobis (isobutyronitril) and 0.015% 2, 2-Azobis (2, 4 - dimethylvaleronitril) added. The entire beginning becomes at a wing agitator approx. 30 min. agitated. Subsequent ones become the stirred air bubbles by application of a negative pressure from the approach remote.

C) Production of a PMMA plate with addition of Blan fixed N washed:

< Desc/ Clms PAGE NUMBER 19>



From 2 silica glass disks (thickness 6mm) a chamber becomes constructed with a cord (diameter 9.6 mm).

Whereby the two silica glass disks and PVC  
Cord with brackets to be held together.

Into the clearance of the silica glass chamber that becomes bottom B) described polymerization beginning filled and the chamber sealed.

The filled chamber becomes into a water bath with a temperature of 40 to 50 C inserted and within approx. 10 hours cured, whereby those became PVC cord in the final phase of the cure remote.

Afterwards the final polymerization in an annealing cabinet becomes conducted with a temperature of 115 C within 3 hours. Afterwards releasing from form becomes made and the Plattengießling with a thickness of 8mm removed at room temperature.

From the plate a plate strip of 595 mm of length became, 84 mm of width and 8 mm of thickness cut. The plate strip became highly polished at the four edges. The two polished 595 mm of long edges became with a reflective adhesive tape (9) of the manufacturer 3M (type: Scotch fire 850) provide, so that light rays, which hit these edges into the plate reflected become.

The plate strips (5) were measured in a particular Messapparatur, which is in the figs 3 and 4 shown. The Messapparatur consists of a rectangular aluminum framework of 708 mm length and 535 mm width (3). At in each case the edge of the aluminum framework, which exhibits the width of 535 mm, in each case two parallel to each other disposed fluorescent tubes (4) of the type are PHILIPS TLD 15W/4

< Desc/ Clms PAGE NUMBER 20>

mounted. The distance of the fluorescent tubes amounts to 599 mm and is so dimensioned with the fact that the plate strips central between the fluorescent tubes inserted can become and that the light emitted of the fluorescent tubes irradiates wide edge of the plate strips into the 84 mm. Underneath the plate strips (5) a plate (7) with a white reflective surface (10) is mounted. The white surface is to reflect light, which withdraws on that the observer of opposite surface of the plate strip (5), to the observer. Above the plate strips (5), the observer directed, the plate strip is provided with a diffuser foil (8) of 0.5 mm of thickness, those the light, which withdraws from the plate strip toward the observer, homogenized. On the diffuser foil is 7

< Desc/ Clms PAGE NUMBER 21>

Measuring points (6) marked, at which the luminance with a brilliance measurer type MINOLTA becomes LUMINANCE METRES 1 measured. The measuring points have the subsequent distances of one of the 84 mm of long edge plate strips: 74 mm; 149 mm; 223 mm; 298 mm; 372 mm; 446 mm; 521 mm.

The subsequent luminances became measured.

Table 1  
EMI21.1

< tb>
< tb> Distance < SEP> of < SEP> Luminance < SEP> (Plate strips < SEP> with
< tb>
< tb>
< tb> Disk edge < SEP> [mm] < SEP> 0, < SEP> 018% < SEP> Barium sulfate) < SEP> [cd/m2]
< tb>
< tb> 74 < SEP> 111
< tb>
< tb>
< tb>
< tb> 149 < SEP> 96
< tb>
< tb>
< tb> 223 < SEP> 86
< tb>
< tb>
< tb> 298 < SEP> 83
< tb>
< tb>
< tb> 372 < SEP> 88
< tb>
< tb>
< tb> 446 < SEP> 99
< tb>
< tb> 521 < SEP> 111
< tb>

Concerning the described above embodiment becomes on the schematic illustrations in Fig. 3 and Fig.

4 referred.